

UNITED STATES DEPARTMENT OF AGRICULTURE

DEPARTMENT CIRCULAR 412

Washington, D. C.

March, 1927

DUSTING WITH MONOHYDRATED COPPER SULPHATE AND LIME FOR CONTROL OF PECAN SCAB

J. B. DEMAREE

Associate Pathologist
and

J. R. COLE

Junior Pathologist

Office of Fruit Diseases, Bureau of Plant Industry

CONTENTS

	Page		Page
Introduction -----	1	Cost of dusting -----	7
Experiments at Thomasville, Ga. -----	2	Suggestions -----	7
Experiments at Albany, Ga. -----	4	Directions for using the copper and lime dust -----	8
Meteorological conditions affecting scab infection -----	6	Summary -----	8

INTRODUCTION

Pecan scab, already a limiting factor in pecan nut production, may become a menace to the new and growing pecan industry in southeastern United States. The fungus¹ causing the disease is becoming better established and more abundant each year in the older pecan-growing sections. During 1926 the disease caused a total loss in the untreated orchards of many localities of the crop from the varieties Schley, Delmas, Alley, Pabst, and Van Deman. The fungus seems to be adapting itself gradually to such varieties as Money-maker, Stuart, and Frotcher—varieties which at one time were considered highly resistant or possibly immune. The commercial control of this disease, therefore, is a matter of great importance to pecan growers in the South.

The writers pointed out in a previous publication² that two to four applications of a standard strength (3-3-50) Bordeaux mixture, properly timed, when supplemented by orchard sanitation, would effectively control pecan scab. Owing to the disagreeable work in-

¹ This fungus has been described, probably incorrectly, as *Fusicladium effusum* Winter.

² DEMAREE, J. B., and COLE, J. R. COMMERCIAL CONTROL OF PECAN SCAB. U. S. Dept. Agr. Circ. 386, 8 p. 1926.

volved in spraying large pecan trees, the scarcity of suitable labor, and the cost of high-powered spray machinery, however, pecan growers have been reluctant to adopt this method of protecting their crops from destruction by the scab fungus.

There has been a widespread interest among pecan growers in the possibilities of controlling the disease by using a dust fungicide. To meet this situation the writers conducted extensive laboratory experiments during 1924 and 1925 to test the relative toxicity of dust fungicides of the various types to spores of the pecan scab fungus. The laboratory tests indicated that a mixture of monohydrated copper sulphate and lime dust largely prevented germination and was also quite toxic to the germ tubes of germinating spores. During the summer of 1926 orchard experiments were conducted to test the efficacy of monohydrated copper sulphate and lime dust under orchard conditions. Two tests were made in Georgia, one at Thomasville and the other near Albany. The purpose of this circular is to furnish pecan growers with the results of dusting experiments for 1926.

EXPERIMENTS AT THOMASVILLE, GA.

The experiments at Thomasville, Ga., were conducted on 20-year-old trees of the Schley variety. The trees averaged 50 feet in height and 45 feet in spread of limbs, exceeding in dimensions the average pecan trees growing in orchards of the Southeast. During the winter preceding the experiments the shucks from the former year's crop of nuts were removed from the trees, and later the ground was plowed with a turning or moldboard plow. The trees had received protective and sanitary treatment for two summers prior to 1926. This treatment seemed to have reduced the disease inoculum in the orchard, as practically no leaf infection appeared during the entire summer of 1926 except on the trees receiving no application of the fungicide. These treatments undoubtedly influenced the results of the experimental work during 1926.

About 8 pounds of a 20-80 commercial mixture of monohydrated copper sulphate and lime dust, analyzing approximately 7 per cent metallic copper, was applied to each tree on May 12, June 11, July 9, and August 3. In order to insure a more uniform distribution of the dust it was applied from both sides of the tree rows. The applications were made between dawn and sunrise. Mornings were selected when the leaves and nuts were wet with either dew or rain.

The results obtained in these experiments were very satisfactory, as shown in Table 1. They were even more remarkable, however, when the type of dusting outfit used is taken into consideration. The machine used was an old-type duster designed to dust peach and apple trees; consequently its power and capacity were inadequate to dust properly the pecan trees selected. The mechanical weakness of the outfit was partly overcome by the use of a tower that placed the operator about 6 feet above the ground. The ordinary 4½-foot discharge pipe was replaced by one 10 feet long, which enabled the operator to do better work in the tops of the trees. The first application was made while the dusting fan was moving at the rate of only 1,100 revolutions a minute. Later applications were made with the fan at its maximum speed of about 2,400 revolutions a minute.

TABLE 1.—*Comparison of results obtained by dusting pecan trees with 20–80 monohydrated copper sulphate and lime mixture and by spraying with 3–3–50 Bordeaux mixture for control of pecan scab at Thomasville, Ga., 1926*

Character of treatment	Number of trees treated	Average quantity of nuts set per tree	Average loss of nuts per tree from causes other than scab ¹	Average loss of nuts per tree due to scab ²	Average quantity of nuts harvested per tree
Dusted four times with monohydrated copper sulphate and lime dust.....	10	Pounds 72.76	Pounds 18.1	Pounds 2.16	Pounds 52.5
Sprayed three times with 3–3–50 Bordeaux mixture.....	2	95.8	23.3	0	72.5
Control (not dusted or sprayed).....	1	82.8	18	60	4.8

¹ Black pit, insect injuries, and high winds.

² Including unmarketable nuts and those which dropped prematurely.

The records of dusted nuts were taken from 10 trees treated alike. The weight of the crop of nuts harvested from these trees ranged from 32.5 to 80 pounds and averaged 52.5 pounds of nuts per tree. There was a heavy drop of nuts due to black pit, insect injuries, and to high winds during July and August. From 20 to 25 per cent of the total crop fell prematurely as a result of the action of those agencies. The nuts that dropped prematurely were gathered at frequent intervals during the season and counted. At the same time the probable cause of the drop was determined. The number of pounds of nuts that dropped was calculated on the basis that 60 nuts, tree run, weigh 1 pound. The quantity of nuts set per tree was computed by adding the estimated number of pounds lost to the total number of pounds harvested. These methods apply also to the records covered by Table 3. The husks of many of the dusted nuts became infected with the scab organism during a 36-hour infection period on August 28 and 29. Fortunately, however, these late infections caused only a small percentage of faulty nuts on those trees dusted or sprayed. No drop occurred as the result of scab, but a few pounds of faulty nuts were found within the centers of the trees and in the extreme topmost parts, presumably where the dust was not properly distributed.

Since Bordeaux mixture is considered the standard fungicide for preventing infection of pecan scab, the record of two trees sprayed three times with Bordeaux mixture is included in Table 1 for comparison with the dusting results.

Taking into consideration the nuts which had dropped prematurely, the control tree set a heavy crop of nuts, estimated at 82.8 pounds. Less than 5 pounds of the total nuts set were classified as marketable at harvest time. A loss of 60 pounds of nuts was due directly to scab, while a loss of 18 pounds was caused by other factors.

The method of grading the nuts shown in Table 2 is one approved by the National Pecan Growers Association for pecans of the general type and shape of the Schley variety. With the exception of the control tree, 25 pounds of nuts were used in obtaining the grading percentage. The grading was done by running the nuts through an improved power grader owned by the National Pecan Growers

Exchange, Albany, Ga. All nuts having a diameter of fifteen-sixteenths inch and over are considered as oversize. The No. 1 grade includes nuts with diameters of fourteen-sixteenths and thirteen-sixteenths inch; the No. 2 grade includes nuts with a diameter of about twelve-sixteenths inch; and the No. 3 grade includes those which pass through an eleven-sixteenths inch opening. A relatively large percentage of the dusted nuts were graded as oversize, while 94 per cent were classed as No. 1 grade and larger.

The classification data of the untreated nuts may seem from a casual examination somewhat misleading, but it must be remembered that these data were taken from less than 5 pounds of marketable nuts harvested from a tree which incurred a loss of 60 pounds as the result of scab.

TABLE 2.—Yield, cracking percentage, and grading percentage of nuts harvested from pecan trees included in the dusting experiments at Thomasville, Ga., 1926

Character of treatment	Number of trees treated	Count of nuts to the pound	Cracking percentage	Grading percentage			
				Over-size	No. 1	No. 2	No. 3
Dusted four times with monohydrated copper sulphate and lime dust.....	10	61	62	14	80	4	2
Sprayed three times with 3-3-50 Bordeaux mixture.....	2	59	61.5	8	74	14	4
Control (not dusted or sprayed).....	1	67	55.4	5	45	39	11

EXPERIMENTS AT ALBANY, GA.

The trees in the experiments at Albany, Ga., averaged about 30 feet in height and 25 feet in spread of limbs. The trees had been seriously affected with scab for two or three years prior to 1926 and had received no prophylactic treatment until 1926. Therefore, no part of the control that resulted from the treatment given during the summer of 1926 can be attributed to the cumulative effects of protective measures of previous years, as was the case in the orchard at Thomasville. The trees selected were located in an area surrounded by extensive plantings of untreated and scab-infected pecan orchards. Nevertheless, primary leaf infection was almost absent. Careful attention was given to sanitation in the block of trees selected, and this factor alone undoubtedly contributed largely to the lightness of the early leaf infection. The machine used was of the same type and model as the one used in the experiments at Thomasville.

The dusted plot consisted of 26 trees of the Schley variety and 6 trees of Alley. Each tree was given about 3 pounds of dust at each application. The first application was made May 14, followed by 3 to 5 others at intervals ranging from 2 to 4 weeks. The results are shown in Table 3.

TABLE 3.—Results of dusting pecan trees with 20-80 monohydrated copper sulphate and lime mixture for control of pecan scab at Albany, Ga., 1926

Plot No.	Variety and treatment	Average quantity of nuts set per tree	Average loss of nuts per tree from causes other than scab ¹	Average loss of nuts per tree due to scab ²	Average quantity of nuts harvested per tree
		<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>
1	Schley, dusted six times.....	24.10	3	0.10	21
2	Schley, dusted five times.....	28.25	4.37	.88	23
3	Schley, dusted four times.....	25.75	2.6	5.15	18
4	Schley, control (not dusted).....	35	2.5	28.9	3.6
5	Alley, dusted five times.....	25.5	4.5	1	20
6	Alley, control (not dusted).....	28	5	20.3	2.7

¹ Black pit, insect injuries, and high winds.² Including unmarketable nuts and those which dropped prematurely.

The drop of nuts due to causes other than scab was about half as heavy in the Albany experiments as in those at Thomasville. The trees of the Schley variety which were dusted five and six times each during the season yielded an average of 22 pounds of marketable nuts per tree, and the yield of the Alley trees averaged 20 pounds of marketable nuts. The control trees of the Schley variety sustained an average loss of 28.9 pounds and yielded only 3.6 pounds of small though marketable nuts. The loss from scab on the check Alley trees averaged 20.3 pounds of nuts, and the marketable crop was only 2.7 pounds of small nuts. Plot 3, dusted four times, sustained a 20 per cent loss from scab. An average of 18 pounds per tree of marketable nuts was harvested from this plot, although the nuts graded undersize.

The nuts harvested from plots 1, 2, and 5, as indicated in Table 4, were normal in size and graded satisfactorily. Plots 1 and 2 graded 94 and 98 per cent, respectively, in the No. 1 class and oversize combined. The nuts harvested from plot 3, dusted four times, were undersize, averaged 70 to the pound, and only 86 per cent were classed as No. 1 and larger. The record of the cracking percentage of the nondusted Schley nuts is significant of the degree of faultiness of these nuts. While the nuts in plot 1 analyzed 62 per cent kernel, those harvested from the control trees analyzed only 36 per cent kernel. The kernels of 70 per cent of these nuts (not indicated in Table 4) were found to be defective in some manner, either shriveled or represented by only a dried mass of the kernel tissues. The cracking percentage of the nondusted Alley nuts was but little better.

The crop harvested from the dusted trees of the Alley variety averaged 70 nuts to the pound, tree run (ungraded), which indicates that these nuts were slightly undersize. Sixty-five nuts to the pound is about normal for nuts of this variety grown in the vicinity of Albany, Ga. Since the diameter of the nuts of the Alley variety is greater in proportion to the length than those of the Schley variety, a different system of grading probably would have been preferable. For the sake of uniformity and conciseness, however, the nuts of both varieties were graded by the same method.

TABLE 4.—Yield, cracking percentage, and grading percentage of nuts harvested from pecan trees included in the dusting experiments at Albany, Ga., 1926

Plot No.	Variety and treatment	Count of nuts to the pound	Crack- ing per- centage	Grading percentage			
				Over- size	No. 1	No. 2	No. 3
1	Schley, dusted six times.....	54	62	14	80	6	0
2	Schley, dusted five times.....	60	58.8	18	80	2	0
3	Schley, dusted four times.....	70	58.2	5	86	8	1
4	Schley, control (not dusted).....	86	36	0	72	22	6
5	Alley, dusted five times.....	70	52.7	38	60	2	0
6	Alley control (not dusted).....	81	48.2	0	54	30	16.

METEOROLOGICAL CONDITIONS AFFECTING SCAB INFECTION

Certain meteorological conditions favor the formation of spores and infection by the pecan scab organism, while other conditions have an inhibitory effect. Little or no infection will occur during periods of fair weather with an absence of heavy dew or fog. Showers, even heavy ones, during the forenoon or early afternoon if followed by bright sunshine apparently do not directly favor infection, but probably do so indirectly by favoring the formation of heavy dews or fogs. Precipitation during the evening, even if very light, may furnish excellent conditions for infection, as the leaves and nuts will then be wet for a period of 12 hours or more. The record of the precipitation during a period of a month or for an entire season is not necessarily a good criterion of conditions favoring infection by pecan scab. A record of the number of rainy days during a month or season is a more accurate criterion. Continuous rainy and cloudy weather extending over a period of four hours or more, even though resulting in only a small aggregate precipitation, may furnish excellent conditions for spore germination and infection. The most favorable infection period during the season of 1926 and the one causing the greatest number of infections and resulting in the greatest loss of nuts occurred July 28 and 29. Rain began falling at 5 o'clock a. m. the first day and continued throughout the day and night until 6 a. m. of the following day. Cloudy weather with intermittent showers continued until 5 o'clock of the afternoon of July 29. This meteorological disturbance furnished a 36-hour infection period.

The summer of 1926 was not exceptionally rainy, but compares very favorably with the average, as indicated by Table 5.

TABLE 5.—Number of days when rain occurred and precipitation during the infection-season months of 1926 at Thomasville, Ga., as compared with a 15-year average (1911 to 1925, inclusive)

[The number of days includes those with a trace of rain; i. e., less than 0.01 of an inch. The data given in this table, as well as all other climatological data given herein, were furnished by the United States Weather Bureau]

Period covered	April		May		June		July		August	
	Days	Inches	Days	Inches	Days	Inches	Days	Inches	Days	Inches
15-year average.....	8	3.40	12	3.80	16	5.29	20	6.61	17	4.72
Season of 1926.....	9	3.49	7	2.69	17	3.52	19	7.06	22	6.59

From May to August, inclusive, the number of rainy days was the same as in the 15-year average. There were three infection periods during May, the driest month. The first occurred on the 4th, when 0.19 inch fell. The rain began at 7 o'clock p. m. and did not cease until after sunset. The second infection period occurred on the 13th, when rain fell between 5.30 and 6.45 p. m. and was followed by overcast skies until after sunset. The last infection period for the month occurred on the 20th, when 1.47 inches fell during a continuous period between 2 o'clock a. m. and 2 o'clock p. m.

COST OF DUSTING

Nothing definite can be said about the cost of dusting. The cost is determined by the size of the trees, price of materials, and labor rates. The factors causing variations differ with every grower. The quantity of dust required to furnish an adequate covering at each application ranges from 1 to 2 pounds to the tree for trees just attaining the bearing age, as compared with 8 to 12 pounds for trees of normal size at the age of 20 to 25 years. Two men can easily operate a power-dusting machine. With such a machine running steadily from 50 to 150 trees an hour can be dusted. A machine costs about \$450 f. o. b. shipping point, and the dust 6 to 7 cents or less per pound. It is possible, therefore, for growers to estimate fairly closely what their own dusting operations will cost.

SUGGESTIONS

As stated previously, this circular gives the results of a single season's success in dusting pecans with monohydrated copper sulphate and lime dust. The writers do not consider that the results of one season's work are sufficiently comprehensive to be used as a basis for dusting schedules. Although the season of 1926 may be considered a normal one from a climatological standpoint, the same schedule which gave success in 1926 may give different results in some other season. Dusting trials over a series of years must be made before definite recommendations can be made. The results of the 1926 experiments are presented at this time so that they may be used as a working basis by growers who wish to test the materials and the method of application herein described.

Sanitation is highly important in a pecan orchard in connection with scab-control operations. The fungus causing the scab disease lives over winter on infected twigs and on infected shucks, leaves, and leaf stems. In order to eliminate as far as possible these sources of infection they should be plowed under previous to the beginning of the spring growth of the trees. The twig stromata are very potent sources of infection and are the most difficult ones to eliminate. To destroy the sporulating powers of the twig stromata, Neal³ and others, of Mississippi, recommend a spray composed of 1 gallon of commercial lime-sulphur solution to 8 gallons of water, to be applied while the trees are dormant. Summer spraying or dusting will largely prevent twig infections. After the first season's control work,

³ NEAL, D. C., CHANCE, O. M., BARNHART, R. P., and BYNUM, E. K. SPRAYING EXPERIMENTS FOR PECAN SCAB CONTROL IN MISSISSIPPI IN 1923. Miss. Agr. Expt. Sta. Circ. 53, 4 p. 1924.

therefore, the trees should be practically free from this source of infection.

The 1926 tests indicate that the dust should be applied at night or early in the morning and only while the leaves and nuts are wet with either dew or rain. To effect a more even distribution of the fungicide the dust should be applied from two sides of the trees.

Judging from the results of the Thomasville experiment, an application of dust made while the leaves are wet will afford protection for about 30 days, whereas applications at intervals of about 20 days were required to furnish protection in the Albany experiment. This difference may be attributed to the fact that the Albany trees had received no previous prophylactic treatment, whereas the Thomasville trees had received such treatment for two years. Furthermore, this difference may be due to the location of the Albany trees in an area surrounded by many trees badly infected with the scab disease. These experiments indicate that the dust should be applied at intervals not exceeding three weeks, at least during the first year of treatment. Further experience and trials may prove that applications of dust at longer intervals will give adequate protection, but for the present it is believed that growers should adhere to the three-week schedule. Very finely divided dust composed of 20 per cent monohydrated copper sulphate and 80 per cent high-grade lime, free from calcium carbonate, seems to give good results.

DIRECTIONS FOR USING THE COPPER AND LIME DUST

Remove last year's infected nuts and shucks from trees during early winter. Plow the orchard soil prior to April 1, so as to cover deeply all infected nuts, shucks, leaves, and leaf stems.

Make the first application of a 20-80 combination of monohydrated copper sulphate and lime dust immediately after pistillate blossoms have been fertilized. Make additional applications of dust of the same strength at intervals of three to four weeks until about August 1. The number of applications and the length of intervals should be governed by the degree of infection as well as by the extent of the control already obtained.

SUMMARY

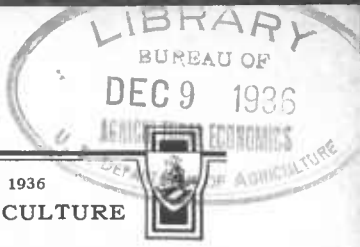
Pecan scab is an important limiting factor to pecan nut production in southeastern United States.

A mixture of monohydrated copper sulphate and lime dust analyzing approximately 7 per cent metallic copper effectively controlled pecan scab in two localities during the summer of 1926.

In addition to orchard sanitation, four to six applications of a 20-80 mixture of monohydrated copper sulphate and lime dust are tentatively recommended. To those who desire to give dusting a trial it is recommended that the dust be applied while the leaves are wet with either dew or rain.

ADDITIONAL COPIES
OF THIS PUBLICATION MAY BE PROCURED FROM
THE SUPERINTENDENT OF DOCUMENTS
GOVERNMENT PRINTING OFFICE
WASHINGTON, D. C.
AT
5 CENTS PER COPY

Copy 1



GROUPS OF PLANTS VALUABLE FOR WILDLIFE UTILIZATION AND EROSION CONTROL

By W. L. McATEE, *technical adviser and research specialist, Office of the Chief,
Bureau of Biological Survey*

CONTENTS

	Page		Page
Introduction.....	1	Plants utilized by wildlife—Continued.	
Plants utilized by wildlife.....	2	Seed producers.....	7
Cover plants.....	3	Plants useful to wildlife that have been recom-	
Browse plants.....	4	mended for erosion control.....	8
Herbage.....	5	Crop and pasture plants.....	8
Mast producers.....	6	Vines, shrubs, and trees.....	9
Fruit producers.....	6	List of plants.....	9

INTRODUCTION

The American public now realizes the evils of soil erosion and is inclined to do everything possible to remedy them. Among methods of controlling erosion, the establishment and maintenance of vegetative cover on the soil is favored as being simple and effective, economical and lasting. Although plants vary in efficiency as soil binders, almost any of them is of some use. Where vegetative cover is to be restored by planting, choice will be limited in most cases by the character of the existing ground surface. If this is badly eroded, relatively few plants are adapted to growth there. Fortunately, among the pioneering types are some that are of value to wildlife.

For example, on Cecil clay loam, a soil of the piedmont section of North Carolina that is often seriously eroded, Lee,¹ a soil surveyor of the Bureau of Chemistry and Soils, reports that—

Abandoned fields first grow up in broom-sedge and brambles, followed the second year by sassafras and sumac bushes, and yellow pine, and in a few years, except on badly eroded areas, there is a good stand of pine. Forested areas support a fair or good growth of white, red, black, post, scarlet, and chestnut oaks, shortleaf or yellow pine, spruce, pitch, and white pines, hickory, black gum, yellow poplar, dogwood, and a few persimmon, locust, sourwood, black walnut, white elm, sweet gum, red cedar, and hemlock trees.

Commenting on these plants, in the order named, it may be said that broomsedge affords good cover, and brambles (that is dewberries, blackberries, and the like) provide both cover and food for small forms of wildlife, including cottontail rabbits, quail, and other game species. Sassafras and sumac fruits are eaten by many birds

¹LEE, W. D., and BACON, S. R. SOIL SURVEY OF BURKE COUNTY, NORTH CAROLINA. U. S. Dept. Agr., Bur. Chem. and Soils, Ser. 1926, no. 22, p. 16. 1930.

and mammals. Yellow pine according to its height furnishes cover for both ground and above-ground fauna and when mature produces in seed years a food supply that is appreciated by many species. In the forests the various oaks, through their acorn crops, contribute heavily to the upkeep of wildlife; all the pines function in the same way as previously noted for the yellow pine; the hickory and walnut are valuable to squirrels and a few other species; the black gum, dogwood, persimmon, and red cedar yield fruits that are sought by a variety of forms of wildlife; the yellow poplar, locust, white elm, and hemlock bear seeds that are eaten in small quantity, and the red cedar in addition to its fruit-bearing role affords first-class cover. Thus practically every plant that the soil surveyor thought deserving of mention as a pioneer on eroded Cecil clay loam is of some value to wildlife.

PLANTS UTILIZED BY WILDLIFE

The story would be the same for other soils and regions, even with their different types of vegetation, for the reason that a very large number of plants are in some degree utilized by wildlife. Considering land plants alone, the parts most eaten are the leaves (often with parts of the branches and stems in woody species, collectively known as browse), the buds, and the fruits or seeds. Fruits of the particular type known as nuts are referred to in the aggregate as mast and are an important food supply for certain domestic as well as for various wild animals.

In addition to browsing, there may be mentioned grazing (that is, feeding on grass and other herbage). This seems to have been the principal mode of feeding of the bison, or buffalo, and is important also to elk, especially in summer. It figures less than is popularly supposed, however, in the feeding habits of deer, antelope, rabbits, and hares, which depend more upon woody plants, or true browse. All these creatures take some grass and herbs, it is true, and the leaves of grass and of many other plants are freely eaten by quail and grouse and nipped by numerous smaller vegetarian birds.

Buds, while taken by the browsers along with leaves and twigs, are sought alone as a substantial part of the diet by grouse and some smaller birds, especially in winter. Fleshy fruits are eaten by mammals in general (except the most pronounced carnivores), by practically all land game birds, and by a great many smaller birds, especially by such groups as the mockingbird, catbird, and thrashers; robins, thrushes, and bluebirds; waxwings; starling; orioles; and tanagers. Mast is the great dependence of squirrels but is taken by many other mammals ranging in size from deer to mice, by wild turkeys, grouse, and quail, and among other birds by woodpeckers, jays, crows, titmice, and nuthatches. Tree seeds are sought while on the trees by squirrels, woodpeckers, jays, pine and evening grosbeaks, redpolls, siskins, goldfinches, and crossbills. When they fall, especially in the case of common pines, black locust, and sweetgum, the seeds may be of great importance for the time being to doves, quail, and various other ground-feeding birds and mammals. Seeds of grasses, sedges, and other herbs contribute substantially to the diet of doves, meadowlarks, blackbirds, cowbirds, redpolls, buntings, finches, sparrows, juncos, and longspurs.



B35728; B3112M

A, Manzanita (*Arctostaphylos*): Evergreen cover, good browse, and persistent fruit. B, Mountain juniper (*Juniperus communis montana*): Excellent evergreen cover, good browse, and persistent fruit.



Aspen (*Populus tremuloides*): One of the best browse and building plants.

W. H. H. H.

The production of food, indispensable though it may be, cannot be ranked unconditionally as first among the uses of plants to wildlife. Food there must be, but the ways of wildlife are such that food can scarcely be utilized unless situated in or near suitable cover. Defining suitable cover may be difficult. One thinks first of its concealing capacity, but there is to be considered also its actual mechanical efficiency in excluding predators or at least in impeding their progress. In summer the provision of shade may be an important attribute of cover, and at all times the convenient location of cover in relation to food supplies is a prime consideration. Man may appraise cover requirements to the best of his ability and plan and modify cover according to this appraisal, but the final test of value is the degree of use, and sometimes this appears to depend upon something that the particular form of wildlife concerned recognizes but man does not. Man does the best he can by providing cover good for quick refuge, temporary concealment, and more or less permanent lodging, using a variety of plants to form it, distributing rather than concentrating it, and making it of food-bearing species or placing it so as to be readily accessible to food supplies.

The genera of plants known to be of most value in providing cover, browse, herbage, mast, fruit, and seeds for wildlife are herewith listed in systematic order.² It is realized that in a single genus the species may differ greatly in value to wildlife, but details for all genera are not well enough known to justify tabulation by species. Any available native species of the genera listed may be transplanted, or representatives (native or exotic) may be obtained from nurseries. No barberries, currants, or buckthorns are included, because they harbor destructive rusts. Omitted also are plants poisonous to man on contact, as poison-ivy and poison sumac, as well as various kinds dangerously poisonous either to wild or to domestic animals, when eaten, as yew, wild cherry, lupine, laurel, rhododendron, and groundsel (*Senecio*).

COVER PLANTS

Cover for ground dwellers consists of plants of sufficient height to conceal the forms of wildlife concerned. It seems most effectual if dense, stiff, thorny, or evergreen (pl. 1). Plants that form thickets even so extensive as to dominate the landscape are good cover species. Cover for the above-ground fauna is most satisfactorily provided by dense evergreen trees. Deciduous plants, on the other hand, unless of very dense growth, are not of much value for cover except in summer.

Pine (*Pinus*).
Spruce (*Picea*).
Hemlock (*Tsuga*).
Douglas fir (*Pseudotsuga*).
Fir, balsam (*Abies*).
Arbervitae (*Thuja*).
White cedar (*Chamaecyparis*).

Juniper, red cedar (*Juniperus*)³
(pl. 1, B).
Scrub palmetto (*Serenoa*).
Greenbrier (*Smilax*).
Waxmyrtle (*Myrica*).
Sweetfern (*Comptonia*).
Willow (*Salix*).

² HELLER, A. A. CATALOGUE OF NORTH AMERICAN PLANTS NORTH OF MEXICO, EXCLUSIVE OF THE LOWER CRYPTOGAMS. Ed. 2, 252 pp. 1900.

³ Such low junipers as *Juniperus communis*, *J. prostrata*, and *J. sabina* are excellent cover; red cedar (*J. virginiana*), an alternate host of apple rust, should not be planted near apple orchards.

Hazel (*Corylus*).
 Birch (*Betula*).
 Alder (*Alnus*).
 Oak (*Quercus*).⁴
 Osage-orange (*Torreyton*).
 Hop (*Humulus*).
 Saltbush (*Atriplex*).
 Winterfat (*Eurotia*).
 Clematis (*Clematis*).
 Cotoncaster (*Cotoncaster*).
 Hawthorn (*Crataegus*).
 Apple (*Malus*).⁵
 Squaw-apple (*Peraphyllum*).
 Blackberry, raspberry (*Rubus*).
 Bush cinquefoil (*Dasiphora*).
 Mountain-mahogany (*Cercocarpus*).
 Chamise (*Adenostoma*).
 Antelope-brush (*Purshia*).
 Blackbrush (*Colocogyne*).
 Bearmat (*Chamaebatia*).
 Rose (*Rosa*).
 Plum (*Prunus*).
 Catclaw (*Acacia*).
 Mimosa (*Mimosa*).
 Mesquite (*Prosopis*).
 Screwbean (*Strombocarpa*).
 Partridge-pea (*Chamaecrista*).
 Paloverde (*Cercidium*).
 Siberian pea-tree (*Caragana*).
 Locust (*Robinia*) (pl. 7, B).
 Prickly-ash (*Zanthoxylum*).
 Jojoba (*Simmondsia*).
 Sumac (*Rhus*).
 Holly (*Ilex*).

Wintercreeper (*Euonymus*, vine species).
 Bittersweet (*Celastrus*).
 Jujube (*Zizyphus*).
 Deer brush, Jersey-tea (*Ceanothus*).
 Grape (*Vitis*).
 Virginia creeper (*Parthenocissus*).
 Saltcedar (*Tamarix*).
 Pricklypear, tuna, cholla (*Opuntia*).
 Buffaloberry (*Lepargyrea*).
 Elaeagnus (*Elaeagnus*).
 Dogwood (*Cornus*) (pl. 4, A).
 Salal (*Gaultheria*).
 Manzanita (*Arctostaphylos*) (pl. 1, A).
 Huckleberry (*Gaylussacia*).
 Blueberry (*Vaccinium*) (pl. 4, B).
 Lantana (*Lantana*).
 Sage (*Salvia*).
 Matrimony-vine (*Lycium*).
 Desertwillow (*Chilopsis*).
 Trumpetcreeper (*Tecoma*).
 Snowberry, coralberry (*Symphoricarpos*).
 Honeysuckle (*Lonicera*).
 Mock-cucumber (*Micrampelis*).
 Climbing boneset (*Mikania*).
 Rabbitbrush (*Chrysothamnus*).
 Seepwillow (*Baccharis*).
 Arrowweed (*Pluchea sericea*).
 Burrobrush (*Hymenoclea*).
 Bur-sage (*Franseria*).
 Brittlebush (*Encelia*).
 Tarbush (*Flourensia*).
 Poreleaf (*Porophyllum*).
 Sagebrush (*Artemisia*).

BROWSE PLANTS

So far as known, the buds of relatively few plants are especially sought by wildlife. The favorite budding trees are *Populus* (pl. 2) and *Betula* with others of their respective families coming next in rank. The catkins of these and other amentaceous plants are eaten. Browse is interpreted to cover bark, buds, and whole pods, particularly pods that are eaten in their entirety, as of mesquite and honeylocust, and whole heads of fruits, as the "bobs" of sumac. Entries in this list preceded by an asterisk (*) are made on the basis of the preferences of range stock, so may not prove well founded for wildlife.

Pine (*Pinus*).
 Tamarack (*Larix*).
 Spruce (*Picea*).
 Hemlock (*Tsuga*).
 Douglas fir (*Pseudotsuga*).
 Fir, balsam (*Abies*).
 Arborvitae (*Thuja*).
 White cedar (*Chamaecyparis*).
 Juniper, red cedar (*Juniperus*) (pl. 1, B).
 Jointfir (*Ephedra*).
 Greenbrier (*Smilax*).

Hickory (*Hicoria*).
 Sweetfern (*Comptonia*).
 Cottonwood, aspen (*Populus*) (pl. 2).
 Willow (*Salix*).
 Blue beech (*Carpinus*).
 Hophornbeam (*Ostrya*).
 Hazel (*Corylus*).
 Birch (*Betula*).
 Alder (*Alnus*).
 Beech (*Fagus*).
 Chestnut (*Castanea*).
 Oak (*Quercus*).

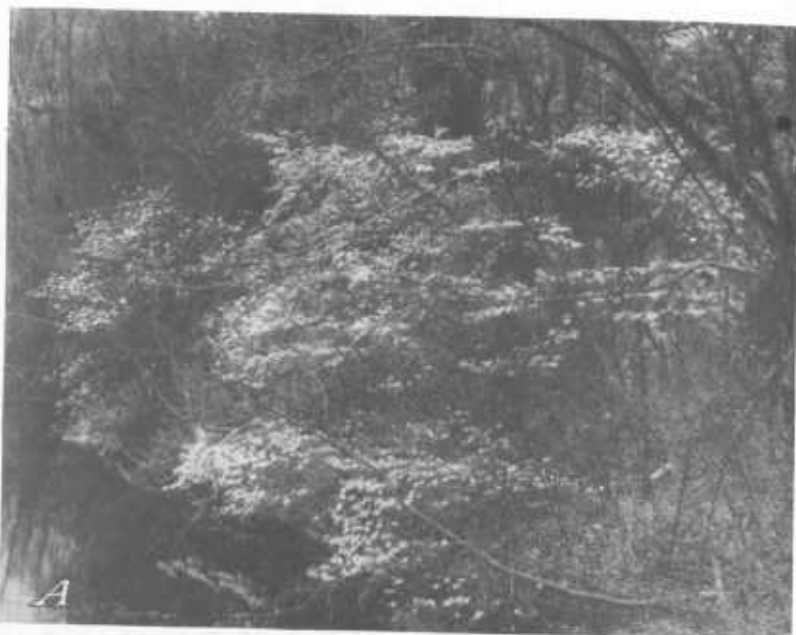
⁴ Scrub oaks and those of any height with persistent or evergreen leaves are the best.

⁵ Crabs and wild seedlings of the cultivated apple.



B2902M

Serviceberry or shadbush (*Amelanchier*): Browse and early season fruit.



B2914M; B3085M

A, Flowering dogwood (*Cornus florida*): Of some value as cover and browse and excellent for persistent fruit. B, A blueberry (*Vaccinium vitis-idaea*): Fair cover, good browse, and excellent summer fruit.

Elm (*Ulmus*).
 Hackberry (*Celtis*).
 Mistletoe (*Razoumofskyia*).
 Buckwheatbrush (*Eriogonum microthecum*, *E. wrightii*).
 Saltbush (*Atriplex*).
 *Hop-sage (*Grayia*).
 Winterfat (*Eurotia*).
 Greasewood (*Sarcobatus*).
 Sassafras (*Sassafras*).
 Witch-hazel (*Hamamelis*).
 Sycamore (*Platanus*).
 Hawthorn (*Crataegus*).
 Apple (*Malus*)⁵.
 Mountain-ash (*Sorbus*).
 Chokeberry (*Aronia*).
 Serviceberry (*Amelanchier*) (pl. 3).
 Squaw-apple (*Peraphyllum*).
 Blackberry, raspberry (*Rubus*).
 Bush cinquefoil (*Dasiphora*).
 *Apache-plume (*Fallugia*).
 Cliffrose (*Cowania*).
 Mountain-mahogany (*Cercocarpus*).
 Antelope-brush (*Purshia*).
 Rose (*Rosa*).
 *False-mesquite (*Calliandra*).
 Catclaw (*Acacia*).
 *Mimosa (*Mimosa*).
 Mesquite (*Prosopis*).
 *Screwbean (*Strombocarpa*).
 Redbud (*Cercis*).
 *Ratany (*Krameria*).
 Honeylocust (*Gleditsia*).

*Jerusalem-thorn (*Parkinsonia*).
 Paloverde (*Cercidium*).
 Pea chaparral (*Pickeringia*).
 *Kidneywood (*Eysenhardtia*).
 Locust (*Robinia neomexicana*).
 Tesota (*Olneya*).
 Jojoba (*Simmondsia*).
 Sumac (*Rhus*).
 Maple (*Acer*).
 Deer brush, Jersey-tea (*Ceanothus*).
 Grape (*Vitis*).
 Basswood (*Tilia*).
 Flannelbush (*Fremontia*).
 *Pricklypear, tuna, cholla (*Opuntia*).
 Buffaloberry (*Lepargyrea*).
 Aralia (*Aralia*).
 Dogwood (*Cornus*) (pl. 4, A).
 Trailing arbutus (*Epigaea*).
 Wintergreen (*Gaultheria*).
 Manzanita (*Arctostaphylos*) (pl. 1, A).
 Huckleberry (*Gaylussacia*).
 Blueberry (*Vaccinium*) (pl. 4, B).
 Ash (*Fraxinus*).
 Matrimony-vine (*Lycium*).
 Elderberry (*Sambucus*) (pl. 5, A).
 Blackhaw, cranberrybush (*Viburnum*).
 Snowberry, coralberry (*Symphoricarpos*).
 Honeysuckle (*Lonicera*).
 Rabbitbrush (*Chrysothamnus*).
 Burrobrush (*Hymenoclea*).
 *Bur-sage (*Franseria*).
 Sagebrush (*Artemisia*).

HERBAGE

Woodfern (*Dryopteris*).
 Bracken (*Pteridium*).
 Galleta (*Hilaria*).
 Cupgrass (*Eriochloa*).
 Switchgrass (*Panicum*).
 Three-awn (*Aristida*).
 Needlegrass (*Stipa*).
 Timothy (*Phleum*).
 Dropseed (*Sporobolus*).
 Bentgrass (*Agrostis*).
 Wild oat (*Avena*).
 Bermuda grass (*Cynodon*).
 Trichloris (*Trichloris*).
 Grama (*Bouteloua*).
 Buffalo grass (*Buchloë*).
 Lovegrass (*Eragrostis*).
 Junegrass (*Koeleria*).
 Orchard grass (*Dactylis*).
 Bluegrass (*Poa*).
 Fescue (*Festuca*).
 Bromegrass (*Bromus*).
 Wheatgrass (*Agropyron*).
 Sedge (*Carex*).
 Spanish-moss (*Tillandsia*).
 Rush (*Juncus*).
 Woodrush (*Juncoides*).
 Wild onion (*Allium*).
 Wood nettle (*Laportea*).
 Wild buckwheat (*Eriogonum*).

Dock (*Rumex*).
 Knotweed (*Polygonum*).
 Lambsquarters (*Chenopodium*).
 Pigweed (*Blitum*).
 Saltbush (*Atriplex*).
 Red sage (*Kochia*).
 Glasswort (*Salicornia*).
 Russian-thistle (*Salsola*).
 Redroot (*Amaranthus*).
 Sheeplick (*Guilleminea*).
 Umbrellawort (*Allionia*).
 Boerhaavia (*Boerhaavia*).
 Carpetweed (*Mollugo*).
 Purslane (*Portulaca*).
 Bitterroot (*Lewisia*).
 Chickweed (*Alsine*).
 Columbine (*Aquilegia*).
 Meadowrue (*Thalictrum*).
 Corydalis (*Capnoides*).
 Wild cabbage (*Caulanthus*).
 Peppergrass (*Lepidium*).
 Mustard (*Brassica*).
 Lesquerella (*Lesquerella*).
 Sophia (*Sophia*).
 Saxifrage (*Saxifraga*).
 Alumroot (*Heuchera*).
 Rice-root (*Lithophragma*).
 Strawberry (*Fragaria*).
 Cinquefoil (*Potentilla*).

⁵ Crabs and wild seedlings of the cultivated apple.

Drymocallis (<i>Drymocallis</i>).	Phlox (<i>Phlox</i>).
Dwarf rose (<i>Chamaerhodos</i>).	Skunkweed (<i>Polemonium</i>).
Huajillo (<i>Pithecolobium</i>).	Waterleaf (<i>Hydrophyllum</i>).
Desmanthus (<i>Desmanthus</i>).	Stickseed (<i>Echinopspermum</i>).
Blueweed (<i>Hoffmanseggia</i>).	Bluebells (<i>Mertensia</i>).
Thermopsis (<i>Thermopsis</i>).	Puccoon (<i>Lithospermum</i>).
Bur-clover (<i>Medicago</i>).	Horsemint (<i>Agastache</i>).
Clover (<i>Trifolium</i>).	Catpaw (<i>Lamium</i>).
Birdsfoot trefoil (<i>Lotus</i>).	Pentstemon (<i>Pentstemon</i>).
Parosela (<i>Parosela</i>).	Speedwell (<i>Veronica</i>).
Prairieclover (<i>Kuhnistera</i>).	Indian paintbrush (<i>Castilleja</i>).
Sweetweed (<i>Hedysarum</i>).	Plantain (<i>Plantago</i>).
Beggarweed (<i>Meibomia</i>).	Partridgeberry (<i>Mitchella</i>).
Bushclover (<i>Lespedeza</i>).	Mexican-clover (<i>Richardia</i>).
Vetch (<i>Vicia</i>).	Cleavers (<i>Galium</i>).
Pea (<i>Lathyrus</i>).	Valerian (<i>Valeriana</i>).
Hogpeanut (<i>Amphicarpa</i>).	Xanthisma (<i>Xanthisma</i>).
Milk pea (<i>Galactia</i>).	Fleabane (<i>Erigeron</i>).
Wild bean (<i>Phaseolus</i>).	Niggerhead (<i>Rudbeckia</i>).
Wild bean (<i>Strophostyles</i>).	Balsamroot (<i>Balsamorhiza</i>).
Geranium (<i>Geranium</i>).	Wyethia (<i>Wyethia</i>).
Alfilaria (<i>Erodium</i>).	Viguiera (<i>Viguiera</i>).
Woodsorrel (<i>Oxalis</i>).	Mountain sunflower (<i>Helianthella</i>).
Jewelweed (<i>Impatiens</i>).	Tallowweed (<i>Actinella</i>).
False mallow (<i>Malvastrum</i>).	Fall tallowweed (<i>Amblyolepis</i>).
Willowweed (<i>Epilobium</i>).	Poreleaf (<i>Porophyllum</i>).
Fireweed (<i>Chamaenerion</i>).	Yarrow (<i>Achillea</i>).
Evening-primrose (<i>Oenothera</i>).	Sagewort (<i>Artemisia</i>).
Sweet cicely (<i>Osmorrhiza</i>).	Arnica (<i>Arnica</i>).
Lovage (<i>Ligusticum</i>).	Thistle (<i>Cirsium</i>).
Angelica (<i>Angelica</i>).	Star-thistle (<i>Centaurea</i>).
Leptotaenia (<i>Leptotaenia</i>).	Dandelion (<i>Taraxacum</i>).
Cogswellia (<i>Cogswellia</i>).	Wild lettuce (<i>Lactuca</i>).
Cow-parsnip (<i>Hieracleum</i>).	False dandelion (<i>Agoseris</i>).
Pyrola (<i>Pyrola</i>).	Hawksbeard (<i>Crepis</i>).
Shepherds-purslane (<i>Androsace</i>).	Hawkweed (<i>Hieracium</i>).
Elkweed (<i>Fraseria</i>).	

MAST PRODUCERS

Walnut (<i>Juglans</i>).	Chestnut, chinquapin (<i>Castanea</i>).
Hickory (<i>Hicoria</i>).	Giant chinquapin (<i>Castanopsis</i>).
Hazel (<i>Corylus</i>).	Oak (<i>Quercus</i>).
Beech (<i>Fagus</i>).	Tanoak (<i>Lithocarpus</i>).

FRUIT PRODUCERS

Inclusion of fruit producers here is mostly on the basis of preference by birds as revealed by stomach analyses; field observations on birds and information of both derivations on mammals may show the desirability of making additions.

Juniper, red cedar (<i>Juniperus</i>) (pl. 1, B).	Sassafras (<i>Sassafras</i>).
Palmetto (<i>Sabal</i>).	Spicebush (<i>Benzoin</i>).
Scrub palmetto (<i>Serenoa</i>).	Cotoneaster (<i>Cotoneaster</i>).
Greenbrier (<i>Smilax</i>).	Hawthorn (<i>Crataegus</i>).
Waxmyrtle (<i>Myrica</i>).	Apple (<i>Malus</i>).
Hackberry (<i>Celtis</i>).	Mountain-ash (<i>Sorbus</i>).
Mulberry (<i>Morus</i>).	Chokeberry (<i>Aronia</i>).
Osage-orange (<i>Toxylon</i>).	Toyon (<i>Heteromeles</i>).
Rouge-plant (<i>Rivina</i>).	Serviceberry (<i>Amelanchier</i>) (pl. 3).
Pokeberry (<i>Phytolacca</i>).	Squaw-apple (<i>Peraphyllum</i>).
Moonseed (<i>Mentispermum</i>).	Blackberry, raspberry (<i>Rubus</i>).
Snailseed (<i>Cebatha</i>).	Strawberry (<i>Fragaria</i>).
Bay (<i>Persea</i>).	Rose (<i>Rosa</i>).
California-laurel (<i>Umbellularia</i>).	Plum (<i>Prunus</i>).
	Chinaberry (<i>Melia</i>).



B13632; B2906M

A, Scarlet elder (*Sambucus pubens*): Fair browse and widely relished fruit. B, A smartweed (*Polygonum*): One of the best seed producers.



Crowberry (*Empetrum*).
 Peppertree (*Schinus*).
 Sumac (*Rhus*).
 Holly (*Ilex*).
 Mountain-holly (*Nemopanthes*).
 Jujube (*Zizyphus*).
 Squawbush (*Condalia*).
 Supplejack (*Berchemia*).
 Grape (*Vitis*).
 Virginia creeper (*Parthenocissus*).
 Ampelopsis (*Ampelopsis*).
 Treebine (*Cissus*).
 Passionflower (*Passiflora*).
 Pricklypear, tuna, cholla (*Opuntia*).
 Daphne (*Daphne*).
 Leatherwood (*Dirca*).
 Sea-buckthorn (*Hippophaë*).
 Buffaloberry (*Leopargyrea*).
 Elaeagnus (*Elaeagnus*).
 Aralia (*Aralia*).
 Tupelo (*Nyssa*).
 Dogwood (*Cornus*) (pl. 4, A).

Wintergreen, salal (*Gaultheria*).
 Madrone (*Arbutus*).
 Manzanita, bearberry (*Arctostaphylos*) (pl. 1, A).
 Huckleberry (*Gaylussacia*).
 Blueberry (*Vaccinium*) (pl. 4, B).
 Bumelia (*Bumelia*).
 Persimmon (*Diospyros*).
 Osmanthus (*Osmanthus*).
 Adelia (*Forestiera*).
 Fringetree (*Chionanthus*).
 Privet (*Ligustrum*).
 Anagua (*Ehretia*).
 Beautyberry (*Callicarpa*).
 Matrimony-vine (*Lycium*).
 Groundcherry (*Physalis*).
 Partridgeberry (*Mitchella*).
 Elderberry (*Sambucus*) (pl. 5, A).
 Blackhaw, cranberrybush (*Viburnum*).
 Snowberry, coralberry (*Symphoricarpos*).
 Honeysuckle (*Lonicera*).

SEED PRODUCERS

Ordinarily weeds are thought of as the principal source of the seeds eaten by wildlife, but seeds of certain trees also are important. There is a popular tendency to group these, and in fact all seeds, nuts, and fruits that can be gleaned from the forest floor, under the term mast. The occasional abundant crops of pine seeds, especially, are referred to as pine mast. For the purpose of this circular, however, the term "mast" is restricted to nuts and acorns, and the word "seeds" is used to include dry (as contrasted with fleshy) fruits in addition to grains, akenes, and other plant fructifications popularly called seeds.

Pine (*Pinus*).
 Spruce (*Picea*).
 Hemlock (*Tsuga*).
 Fir, balsam (*Abies*).
 Beardgrass (*Andropogon*).
 Bull grass (*Paspalum*).
 Switchgrass (*Panicum*).
 Wild millet (*Echinochloa*).
 Crabgrass (*Digitaria*).
 Bristle grass (*Setaria*).
 Canary grass (*Phalaris*).
 Needlegrass (*Stipa*).
 Timothy (*Phleum*).
 Dropseed (*Sporobolus*).
 Bentgrass (*Agrostis*).
 Bermuda grass (*Cynodon*).
 Grama (*Bouteloua*).
 Goosegrass (*Eleusine*).
 Keygrass (*Monanthochloë*).
 Lovegrass (*Eragrostis*).
 Saltgrass (*Distichlis*).
 Bluegrass (*Poa*).
 Fescue (*Festuca*).
 Bromegrass (*Bromus*).
 Barley (*Hordeum*).
 Nutgrass (*Cyperus*).
 Sedge (*Carex*).
 Dayflower (*Commelina*)

Blue beech (*Carpinus*).
 Hophornbeam (*Ostrya*).
 Birch (*Betula*).
 Alder (*Alnus*).
 Elm (*Ulmus*).
 Hemp (*Cannabis*).
 Wild buckwheat (*Eriogonum*).
 Dock (*Rumex*).
 Smartweed (*Polygonum*) (pl. 5, B).
 Lambsquarters (*Chenopodium*).
 Tumbleweed (*Cyclopoma*).
 Saltbush (*Atriplex*).
 Russian-thistle (*Salsola*).
 Redroot (*Amaranthus*).
 Carpetweed (*Mollugo*).
 Rockpurslane (*Calandrinia*).
 Indian lettuce (*Montia*).
 Purslane (*Portulaca*).
 Catchfly (*Silene*).
 Campion (*Lychnis*).
 Chickweed (*Alsine*).
 Chickweed (*Cerastium*).
 Sandwort (*Arenaria*).
 Spurry (*Spergula*).
 Magnolia (*Magnolia*).
 Tuliptree (*Liriodendron*).
 Buttercup (*Ranunculus*).
 California-poppy (*Eschscholtzia*).

Mustard (*Brassica*).
 Shepherds-purse (*Bursa*).
 Sweetgum (*Liquidambar*).
 Cinquefoil (*Potentilla*).
 Catclaw (*Acacia*).
 Senna (*Cassia*).
 Partridge-pea (*Chamaecrista*).
 Honeylocust (*Gleditsia*).
 Bur-clover (*Medicago*).
 Sweetclover (*Melilotus*).
 Clover (*Trifolium*).
 Locust (*Robinia*) (pl. 7, B).
 Sesbania (*Sesban*).
 Pencil flower (*Stylosanthes*).
 Beggarweed (*Meibomia*).
 Bushclover (*Lespedeza*).
 Vetch (*Vicia*).
 Wild pea (*Lathyrus*).
 Hogpeanut (*Amphicarpa*).
 Milk pea (*Galactia*).
 Wild bean (*Strophostyles*).
 Geranium (*Geranium*).
 Alfilaria (*Erodium*).
 Wood sorrel (*Oxalis*).
 Doveweed (*Croton*).
 Turkey mullein (*Ereunocarpus*).
 Capperleaf (*Acalypha*).
 Cowitch (*Tragia*).
 Queen's delight (*Stillingia*).
 Bittersweet (*Celastrus*).
 Burningbush (*Euonymus*).
 Maple (*Acer*).
 Jewelweed (*Impatiens*).

Deer brush, Jersey-tea (*Ceanothus*).
 Mallow (*Malva*).
 Sida (*Sida*).
 Hibiscus (*Hibiscus*).
 Violet (*Viola*).
 Evening-primrose (*Oenothera*).
 Ash (*Fraxinus*).
 Morning-glory (*Ipomoea*).
 Bindweed (*Convolvulus*).
 Dodder (*Cuscuta*).
 Heliotrope (*Heliotropium*).
 Amsinckia (*Amsinckia*).
 Puccoon (*Lithospermum*).
 Verbena (*Verbena*).
 Lippia (*Lippia*).
 Bluecurls (*Trichostema*).
 Plantain (*Plantago*).
 Buttonbush (*Cephalanthus*).
 Buttonweed (*Diodes*).
 Cleavers (*Galium*).
 Marsh-elder (*Iva*).
 Ragweed (*Ambrosia*).
 Sunflower (*Helianthus*).
 Bur-marigold (*Bidens*).
 Tarweed (*Madia*).
 Tarweed (*Hemizonia*).
 Canomile (*Anthemis*).
 Thistle (*Cirsium*).
 Milkthistle (*Silybum*).
 Star-thistle (*Centaurea*).
 Dandelion (*Taraxacum*).
 Sowthistle (*Sonchus*).
 Wild lettuce (*Lactuca*).

PLANTS USEFUL TO WILDLIFE THAT HAVE BEEN RECOMMENDED FOR EROSION CONTROL

CROP AND PASTURE PLANTS

The province of this publication is to deal chiefly with wild or naturalized plants of recognized value to wildlife rather than with cultivated sorts, the utilization of which by wildlife is often the cause of economic loss. Some agricultural plants should be mentioned, however, as they are of pronounced value in erosion control. They have the very great merit, moreover, of promptly yielding products that may pay for their planting and care. Where lands still tillable are concerned, the first effort in erosion control usually is to establish some of the commonly planted grasses or legumes. Rye, or rye and sweetclover,⁶ for instance, are highly recommended for the Midwest; but from among the cereal grains, the pasture and hay grasses, and the legumes (clover, bushclover, sweetclover, cowpea, soybean), or combinations of these, vegetative covering can be quickly established while more time-consuming methods are under advisement or in early but ineffective stages of development. Lespedezas (pl. 6, A) are used in protecting the surface where cultivation is being abandoned, especially on account of their supplementary value to wildlife. They even have a place in gully planting (pl. 6, B).

⁶ The seeds of sweetclover are reported by Paul L. Errington (letter) to be somewhat poisonous to bobwhites and pheasants.



SCS-28-380; SCS-28-379

A, "Galled" ridge completely covered with grass and lespedeza. "Save the surface and save all." B, Gully bank with a good cover of Korean lespedeza and *Lespedeza sericea*. (Photographs from Soil Conservation Service.)



A, Badly eroding gully. B, Gully shown in A stabilized by planting of black locust (*Robinia pseudoacacia*).
(Photographs from Soil Conservation Service.)

SCS2-323 (20); SCS2-323 (19)

Sizable seeds of both grasses and legumes are consumed by various wild creatures, and some toll, usually not objectionable in extent, is taken of their foliage. Most of the forage and grain crops furnish summer cover, but as a rule they are not of value as winter shelter. Where wildlife feeding is an objective, patches of these crops are devoted to the purpose. They are of most value to wildlife if the sowings are near good refuge cover of low, dense, woody, and, preferably, evergreen plants.

VINES, SHRUBS, AND TREES

On untillable land and on land where erosion has removed practically all the topsoil, plantings of a more permanent nature than field crops or even pasture plants are likely to be required. It is in this respect, and especially for stabilizing gullies⁷ (pl. 7), that the vines, shrubs, and trees so useful in providing cover and food for wildlife have an important use. They will serve also for binding soil on steep slopes, on stream and ditch banks, and on terrace margins. For the sake of their value to wildlife, for improving the appearance of landscapes, and for yielding wood and other products of direct value to man, they may well be encouraged on any spots of rough or infertile land or on other uncultivated parts of the farm.

LIST OF PLANTS

The recommendations here compiled have been based in part on possession by the plants of far-reaching root systems or of the habit of making dense growth and in part on the capacity of the plants to grow on lands denuded of topsoil. This latter quality accounts for inclusion of the tap-rooted pines and some other relatively weak-rooted plants that have, however, marked ability to pioneer on barren ground. Arrangement is in systematic order. Letters indicate that the plant or group of plants is of value for cover (C), browse (B), herbage (H), mast (M), fruit (F), or seeds (S).

Pine.....	<i>Pinus</i> spp.....	C B S
Norway spruce.....	<i>Picea excelsa</i>	C B S
White spruce.....	<i>Picea glauca</i>	C B S
Black spruce.....	<i>Picea nigra</i>	C B S
Douglas fir.....	<i>Pseudotsuga taxifolia</i>	C B
White cedar.....	<i>Chamaecyparis thyoides</i>	C B
Common juniper.....	<i>Juniperus communis</i>	C B F
Irish juniper.....	<i>Juniperus communis hibernica</i>	C B F
Creeping juniper.....	<i>Juniperus horizontalis</i>	C B F
Rocky mountain juniper.....	<i>Juniperus scopulorum</i>	C B F
Red cedar.....	<i>Juniperus virginiana</i>	C B F
Beardgrass, bluestem.....	<i>Andropogon</i> spp.....	H S
Galleta, tobosa, curly mesquite.....	<i>Hilaria</i> spp.....	H
Knotgrass.....	<i>Paspalum distichum</i>	S
Creeping bent.....	<i>Agrostis palustris</i>	H S
Colonial bent.....	<i>Agrostis tenuis</i>	H S
Needlegrass.....	<i>Stipa</i> spp.....	H S
Dropsced, sacaton.....	<i>Sporobolus</i> spp.....	H S
Gramma.....	<i>Bouteloua</i> spp.....	H S
Buffalo grass.....	<i>Buchloë dactyloides</i>	H
Junegrass.....	<i>Koeleria cristata</i>	H

⁷ MEGINNIS, H. G. USING SOIL-BINDING PLANTS TO RECLAIM GULLIES IN THE SOUTH. U. S. Dept. Agr., Farmers' Bull. 1697, 17 pp., illus. 1933. Obtainable from Superintendent of Documents, Washington, D. C., for 5 cents a copy.

Bluegrass	<i>Poa</i> spp	HS
Fescues	<i>Festuca</i> spp	HS
Wheatgrasses	<i>Agropyron</i> spp	H
Greenbrier	<i>Smilax</i> spp	C B F
Butternut	<i>Juglans cinerea</i>	M
Black walnut	<i>Juglans nigra</i>	M
Texas walnut	<i>Juglans rupestris major</i>	M
Mockernut	<i>Hicoria alba</i>	B M
Pignut	<i>Hicoria glabra</i>	B M
Shagbark	<i>Hicoria ovata</i>	B M
Sweetfern	<i>Comptonia asplenifolia</i>	C B
California waxmyrtle	<i>Myrica californica</i>	C F
Northern bayberry	<i>Myrica carolinensis</i>	C F
Carolina poplar	<i>Populus eugenei</i>	B
Western cottonwood	<i>Populus deltoides</i>	B
Cottonwood	<i>Populus sargentii</i>	B
Aspen	<i>Populus tremuloides</i>	B
Willow	<i>Salix</i> spp	C B
Hazelnut	<i>Corylus americana</i>	C B M
Birch	<i>Betula</i> sp	C B S
Alder	<i>Alnus</i> spp	C B S
Beech	<i>Fagus grandifolia</i>	B M
Hairy chestnut	<i>Castanea mollissima</i>	B M
Chinquapin	<i>Castanea pumila</i>	B M
Oak	<i>Quercus</i> spp. ⁸	C B M
American elm	<i>Ulmus americana</i>	B S
Chinese elm	<i>Ulmus parvifolia</i>	B S
Siberian elm	<i>Ulmus pumila</i>	B S
Hackberry	<i>Celtis</i> spp	B F
Russian mulberry	<i>Morus alba tatarica</i>	F
Red mulberry	<i>Morus rubra</i>	F
Black mulberry	<i>Morus nigra</i>	F
Osage-orange	<i>Toxylon pomiferum</i>	C F
Saltbushes	<i>Atriplex</i> spp	C B S
Greasewood	<i>Sarcobatus vermiculatus</i>	B
Cucumbertree	<i>Magnolia acuminata</i>	S
Tuliptree	<i>Liriodendron tulipifera</i>	S
Silkvine	<i>Clematis drummondii</i>	C
Moonseed	<i>Menispermum canadense</i>	F
Asiatic moonseed	<i>Menispermum dauricum</i>	F
Sassafras	<i>Sassafras variifolium</i>	B F
Sweetgum	<i>Liquidambar styraciflua</i>	S
Rock cotoneaster	<i>Cotoneaster horizontalis</i>	C F
Hawthorn	<i>Crataegus</i> spp	C B F
Narrowleaf firethorn	<i>Pyracantha angustifolia</i>	C B F
Scarlet firethorn	<i>Pyracantha coccinea</i>	C B F
Chokeberry	<i>Aronia</i> spp	B F
American mountain-ash	<i>Sorbus americana</i>	B F
European mountain-ash	<i>Sorbus aucuparia</i>	B F
Apple	<i>Malus</i> spp	C B F
Serviceberry	<i>Amelanchier canadensis</i>	B F
Blackberry, raspberry	<i>Rubus</i> spp	C B F
Apache-plume	<i>Fallugia paradoxa</i>	B
Rose	<i>Rosa</i> spp	C B F
Wild plum	<i>Prunus americana</i>	C F
Mesquite	<i>Prosopis glandulosa</i>	C B
Honeylocust	<i>Gleditsia triacanthos</i>	B
Paloverde	<i>Cercidium</i> spp	C B
Siberian pea-tree	<i>Caragana arborescens</i>	C
Wisteria	<i>Kraunkia frutescens</i>	C
Black locust	<i>Robinia pseudoacacia</i>	C S
Shrub bushclover	<i>Lespedeza bicolor</i>	H S
Shrub bushclover	<i>Lespedeza cyrtobotrya</i>	H S
Wild bean	<i>Strophostyles helvola</i>	H S

⁸ The scrub oaks are best.

Sumac	<i>Rhus</i> spp.	C B F
Possumhaw	<i>Ilex decidua</i>	C F
Inkberry	<i>Ilex glabra</i>	C F
Holly	<i>Ilex opaca</i>	C F
Black alder	<i>Ilex verticillata</i>	C F
Wahoo	<i>Euonymus atropurpureus</i>	S
Wintercreeper	<i>Euonymus radicans</i>	C S
Burningbush	<i>Euonymus europaeus</i>	S
Oriental bittersweet	<i>Celastrus orbiculatus</i>	C S
American bittersweet	<i>Celastrus scandens</i>	C S
Canotia	<i>Canotia holacantha</i>	C
Boxelder	<i>Acer negundo</i>	B S
Red maple	<i>Acer rubrum</i>	B S
Sugar maple	<i>Acer saccharum</i>	B S
Silver maple	<i>Acer saccharinum</i>	B S
Texas jujube	<i>Zizyphus obtusifolia</i>	C F
Squawbush	<i>Condalia</i> spp.	F
Jersey-tea	<i>Ceanothus americanus</i>	C B S
Grape	<i>Vitis</i> spp.	C B F
Virginia creeper	<i>Parthenocissus quinquefolia</i>	C F
Linden	<i>Tilia heterophylla</i>	B
Basswood	<i>Tilia glabra</i>	B
Hibiscus	<i>Hibiscus</i> spp.	S
Flannelbush	<i>Fremontodendron californicum</i>	C
Saltcedar	<i>Tamarix gallica</i>	C
Athel tree	<i>Tamarix aphylla</i>	C
Allthorn	<i>Koerberlinia spinosa</i>	C
Pricklypear, tuna, cholla	<i>Opuntia</i> spp.	C B F
Silver buffaloberry	<i>Lepargyrea argentea</i>	C B F
Russian-olive	<i>Elaeagnus angustifolia</i>	C F
Silky dogwood	<i>Cornus amomum</i>	C B F
Gray dogwood	<i>Cornus paniculata</i>	C B F
Flowering dogwood	<i>Cornus florida</i>	C B F
Red-osier	<i>Cornus stolonifera</i>	C B F
Mossheath	<i>Cassiope</i> spp.	B
Wintergreen	<i>Gaultheria procumbens</i>	C B F
Pinemat	<i>Arctostaphylos nevadensis</i>	C B F
Bearberry	<i>Arctostaphylos uva-ursi</i>	C B F
Huckleberry, dangleberry	<i>Gaylussacia</i> spp.	C B F
Blueberry	<i>Vaccinium</i> spp.	C B F
Persimmon	<i>Diospyros virginiana</i>	F
Buckthorn bumelia	<i>Bumelia lycioides</i>	F
White ash	<i>Fraxinus americana</i>	B S
Green ash	<i>Fraxinus lanceolata</i>	B S
Fringetree	<i>Chionanthus virginica</i>	F
Amur privet	<i>Ligustrum amurense</i>	F
Regel privet	<i>Ligustrum ibota regelianum</i>	F
European privet	<i>Ligustrum vulgare</i>	F
Beautyberry	<i>Callicarpa americana</i>	F
Desertwillow	<i>Chilopsis linearis</i>	C
Trumpetcreeper	<i>Tecoma radicans</i>	C
Elderberry	<i>Sambucus</i> spp.	B F
Cranberrybush, arrowwood, black-haw.	<i>Viburnum</i> spp.	B F
Coralberry, snowberry	<i>Symphoricarpos</i> spp.	C B F
Sweet honeysuckle	<i>Lonicera caprifolium</i>	C B F
Tatarian honeysuckle	<i>Lonicera tatarica</i>	C B F
Fly honeysuckle	<i>Lonicera xylosteum</i>	C B F
Rabbitbrush	<i>Chrysothamnus</i> spp.	C B
Seepwillow	<i>Baccharis glutinosa</i>	C
Burrobrush	<i>Hymenoclea monogyra</i>	C B
Brittlebush	<i>Encelia farinosa</i>	C
Estafiate	<i>Artemisia frigida</i>	C B
Bud sagebrush	<i>Artemisia spinescens</i>	C B
Big sagebrush	<i>Artemisia tridentata</i>	C B

ORGANIZATION OF THE UNITED STATES DEPARTMENT OF AGRICULTURE WHEN THIS PUBLICATION WAS LAST PRINTED

<i>Secretary of Agriculture</i> -----	HENRY A. WALLACE.
<i>Under Secretary</i> -----	RENFORD G. TUGWELL.
<i>Assistant Secretary</i> -----	M. L. WILSON.
<i>Director of Extension Work</i> -----	C. W. WARBURTON.
<i>Director of Finance</i> -----	W. A. JUMP.
<i>Director of Information</i> -----	M. S. EISENHOWER.
<i>Director of Personnel</i> -----	W. W. STOCKBERGER.
<i>Director of Research</i> -----	JAMES T. JARDINE.
<i>Solicitor</i> -----	MASTIN G. WHITE.
<i>Agricultural Adjustment Administration</i> ----	H. R. TOLLEY, <i>Administrator</i> .
<i>Bureau of Agricultural Economics</i> -----	A. G. BLACK, <i>Chief</i> .
<i>Bureau of Agricultural Engineering</i> -----	S. H. McCORRY, <i>Chief</i> .
<i>Bureau of Animal Industry</i> -----	JOHN R. MOHLER, <i>Chief</i> .
<i>Bureau of Biological Survey</i> -----	IRA N. GABRIELSON, <i>Chief</i> .
<i>Bureau of Chemistry and Soils</i> -----	HENRY G. KNIGHT, <i>Chief</i> .
<i>Commodity Exchange Administration</i> -----	J. W. DUVEL, <i>Chief</i> .
<i>Bureau of Dairy Industry</i> -----	O. E. REED, <i>Chief</i> .
<i>Bureau of Entomology and Plant Quarantine</i> -----	LEE A. STRONG, <i>Chief</i> .
<i>Office of Experiment Stations</i> -----	JAMES T. JARDINE, <i>Chief</i> .
<i>Food and Drug Administration</i> -----	WALTER G. CAMPBELL, <i>Chief</i> .
<i>Forest Service</i> -----	FERDINAND A. SILCOX, <i>Chief</i> .
<i>Bureau of Home Economics</i> -----	LOUISE STANLEY, <i>Chief</i> .
<i>Library</i> -----	CLARIBEL R. BARNETT, <i>Librarian</i> .
<i>Bureau of Plant Industry</i> -----	FREDERICK D. RICHEY, <i>Chief</i> .
<i>Bureau of Public Roads</i> -----	THOMAS H. MACDONALD, <i>Chief</i> .
<i>Soil Conservation Service</i> -----	H. H. BENNETT, <i>Chief</i> .
<i>Weather Bureau</i> -----	WILLIS R. GREGG, <i>Chief</i> .

This circular is a contribution from

Bureau of Biological Survey----- IRA N. GABRIELSON, *Chief*.